

# The Relationship between Semantic-similarity-based Cognitive Diversity and Discussion Effectiveness in an Intelligent Discussion System

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## INTRODUCTION

Cognitive diversity has been manipulated as the wide range of semantic categories (Nijstad, Stroebe, & Lodewijckx, 2002), low related categories (Baruah & Paulus, 2016) and so on. However, these kinds of cognitive diversity were determined before group discussion and would not change dynamically during the discussion, which could be called static cognitive diversity. Compared to this, adaptive cognitive diversity was defined as the adaptive difference with the previous semantic domain in group discussion. For manipulation, stimuli which were different from the previous dynamic semantic domain were given after automatically identifying the previous semantic domain in the discussion (Gao, Yang, Xu, & Hu, 2019). Results showed that compared with the homogeneous condition, discussion breadth of the participants increased under the diverse condition, participants subjectively considered that the opinions provided by virtual agents were more helpful and the understanding on the discussion questions was more comprehensive under the diverse condition.

According to search for ideas in associative memory (SIAM) model, when the stimulation ideas are diverse (from a wide range of semantic categories), the diversity of idea production will be increased (more categories are surveyed). However, according to a refined model of the effects of diversity on elaboration and innovation, diversity can lead to greater elaboration and innovation when the task categories are moderately different. Too much overlap in categories can lead to redundant ideas and semantic fixation, whereas too much dissimilarity yields ideas that may be hard to combine later when elaboration is required (Paulus, van der Zee, & Kenworthy, 2018).

Therefore, a key question is how much difference and how much similarity are best for discussion effectiveness. To answer this question, based on previous study of category-based adaptive cognitive diversity, this study aims to analyze the relationship between semantic similarity and discussion effectiveness.

## METHOD

### Data source

The category-based adaptive cognitive diversity data used was from a previous study (Gao et. al., 2019). A total of 44 undergraduate students participated in groups of two for a total of 22 groups. During the discussion, the virtual agent provided ideas from the same (homogeneous condition) or different (diverse condition) category after identifying the semantic category of participants' previous contribution. The dependent variables included the breadth of discussion (the number of categories participants mentioned) and the depth of discussion (the number of views per category).

### Semantic similarity assessment

The semantic similarity between computer agent's ideas and participants' ideas was evaluated by two independent raters. Firstly, they evaluated the discussion records of two groups to form the assessment criteria. Then, they negotiated the inconsistent assessment to achieve consensus. Finally, they rated the remain discussion records. The correlation between the two raters' rating was 0.97.

## RESULT

(1) The relationship between semantic similarity and semantic category

There were two conditions (diverse condition and homogeneous condition) for semantic category. The independent sample t-test of semantic similarity under these two conditions showed that the semantic similarity of homogeneous group ( $M=6.20$ ) was significantly greater than that of diverse groups ( $M=2.84$ ),  $t(20)=5.92$ ,  $p<0.001$  (see Figure 1)

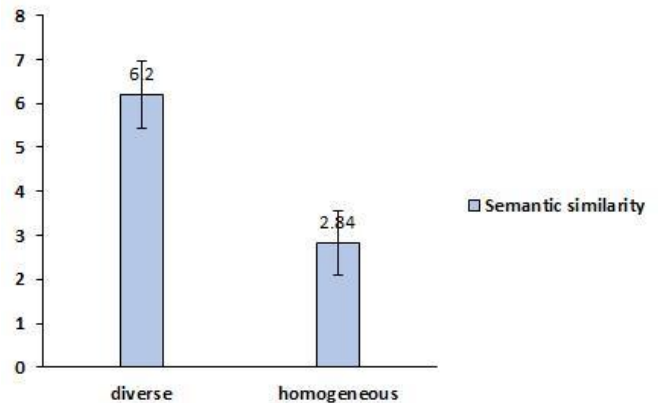


Figure 1 Comparison of semantic similarity between homogeneous group and diverse group

(2) The relationship between semantic similarity and discussion effectiveness

The Pearson product difference correlation analysis showed that there was significantly negative correlation between semantic similarity and the number of categories participants mentioned during the discussion (breadth of discussion),  $r=-0.49$ ,  $p<0.05$ .

The Pearson product difference correlation analysis showed that there was no significant correlation between the semantic similarity and the number of views per category participants mentioned during the discussion (depth of discussion),  $r=0.18$ ,  $p>0.05$ .

## SUMMARY

This study explored the relationship between semantic-similarity-based and category-based cognitive diversity, the relationship between semantic similarity and discussion effectiveness. The data about category-based-cognitive and group discussion were from a previous study (Gao et. al., 2019). The semantic similarity data were from the coding of two researchers. The results indicated that the semantic similarity in diverse condition was lower than that in the homogeneous condition. With the increase of semantic similarity, the breadth of discussion (the number of categories) tended to decrease, while it was not the situation for depth of discussion (the number of ideas per category). This study laid the foundation for future research on automatic semantic-similarity-based cognitive diversity.

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